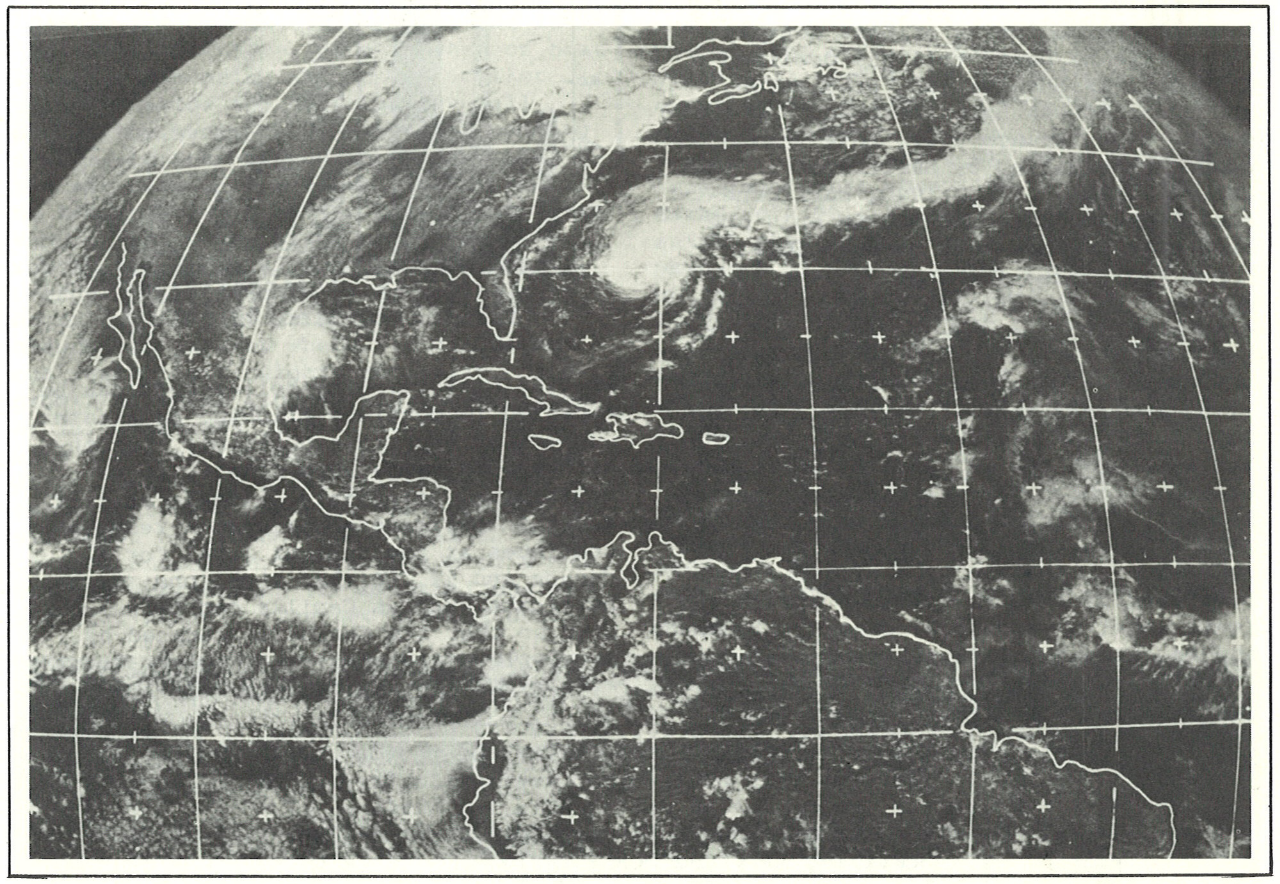
PROJECT STORMFURY 1972

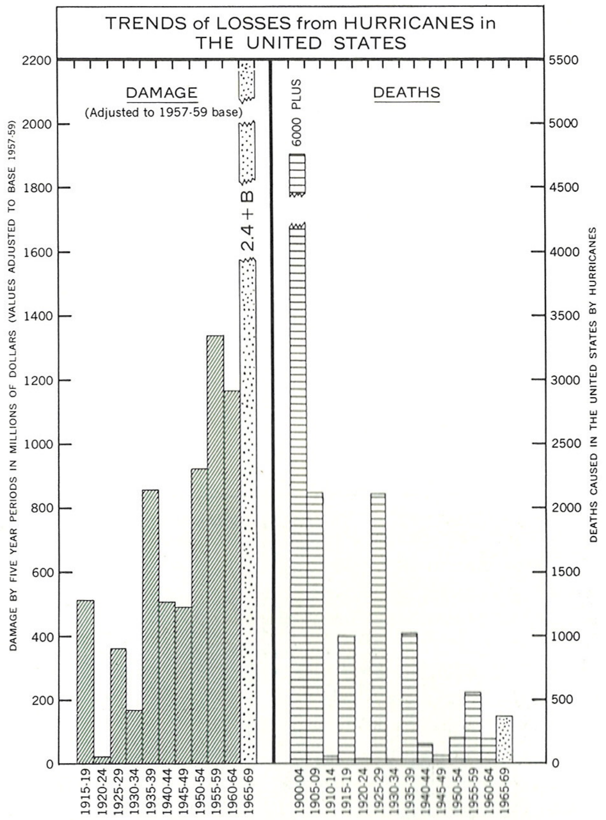


PROJECT STORMFURY

Project Stormfury is a joint Department of Commerce-Department of Defense program of scientific experiments designed to explore the structure and dynamics of hurricanes and tropical storms. Participating agencies are the Commerce Department's National Oceanic and Atmospheric Administration, and the U.S. Navy and U.S. Air Force from the Department of Defense. The Project's objectives are to achieve a better understanding, improve prediction, and examine the possibility of modifying some aspects of these storms.

Hurricane damage is caused by wind, rain, and flood, but principally by the wind-driven storm surge which sends the sea onto the land. If the wind speed, and hence the wind force, of hurricanes can be lessened as they approach land, both death and damage may be reduced materially.

Since the beginning of this century, the hurricane death toll has declined markedly, as observation, prediction, and preparedness have improved. In the decade 1900 through 1909, more than 8000 people were killed by hurricanes in the United States. Since 1940, hurricane-caused deaths exceeded 500 in only one five-year period--1955 through 1959.



But the decreasing loss of life is mirrored by the sharply rising property damage during the same period. Adjusting damage totals to the 1957-59 base of the Commerce Department's composite construction cost index, hurricanes caused less than $400 million in damage during the five-year period 1925-29, while deaths exceeded 2000. For the five-year period 1960-64, hurricane damages were nearly $1.2 billion, while the figure for 1965-69 rose to more than $2.4 billion. One hurricane of 1970 -- Celia -- struck the Texas coast on August 3, causing 11 deaths and an estimated $454 million damage -- the fifth highest hurricane-damage figure in U.S. history. The dollar cost can be expected to continue climbing as greater numbers of expensive buildings are constructed in vulnerable coastal areas.

Stormfury scientists estimate that if Federal hurricane modification research continues at the present level for a decade and if, in that time, one severe hurricane such as Camille can be weakened so that its damage is reduced by as little as 10 percent, the investment will have been returned tenfold.

NOTE TO EDITORS: Glossy prints of photographs in this publication are available from the Office of Public Affairs, National Oceanic and Atmospheric Administration, Rockville, Maryland 20852.

THE COVER PHOTOGRAPH shows Hurricane Ginger of 1971, as photographed by an Applications Technology Satellite.

THE PROJECT'S THEORETICAL BASIS

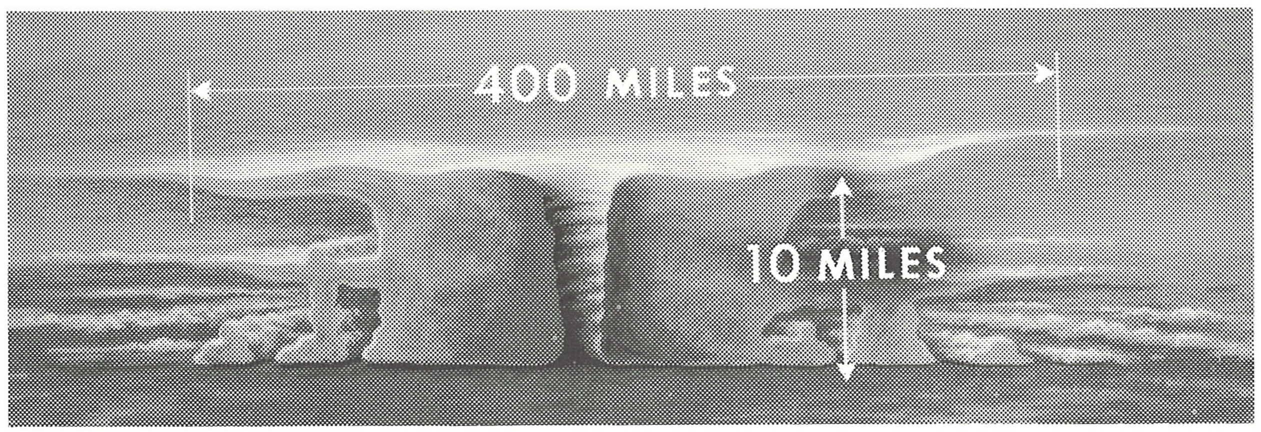
A tropical cyclone draws its energy from the convective overturning of the atmosphere. Warm, moist air spirals over the tropical seas toward the storm center and flows upward in a band of clouds ringing the calm eye. The inflowing air, already turning slowly with the rotation of the earth, gathers speed as it draws toward the storm center, producing winds of destructive violence before moving upward and away from the storm's core.

One Project Stormfury experiment is designed to change the forces in the clouds around the eye of the tropical cyclone, causing redistribution of the energy concentrated around the storm center. Theoretically, injection of silver iodide particles into the clouds outside the eye should transform supercooled water droplets to ice crystals, releasing the latent heat of fusion. The release of heat into the ascending air in the smaller clouds outside the principal eyewall clouds increases cloud buoyancy, causing a more vigorous ascending motion. As the air rises, it expands, cools, and is no longer able to retain all of its water vapor. The water vapor condenses or sublimates, releasing additional heat energy. This process is more likely to occur outside the principal eyewall clouds, in an area where all clouds do not reach great heights naturally. The growth of these clouds, and the addition of large amounts of heat in the area outside the most intense clouds in the eyewall, reduce the great differences in temperature and pressure that produce the strongest hurricane winds. All of these changes encourage the formation of a new eyewall surrounding the original one at a larger radius. The new eyewall draws off inflowing air before it can reach the old one. The farther from the storm's center this inflow ceases, the less the wind will be. The energy formerly concentrated in a tight ring around the center is dispersed over a greater area, causing a decrease in maximum winds.

Research in the numerical modeling of hurricanes at NOAA's National Hurricane Research Laboratory, Miami, Florida, holds particular significance to the evaluation of experimental modification efforts. Since changes occurring in seeded tropical cyclones are rarely larger than the changes which may occur naturally in unmodified storms, the process of evaluating a field modification experiment is particularly difficult. A theoretical model that can identify changes expected to occur in a modified storm can be a valuable tool. Output from such a model can indicate which data need to be collected in field experiments in order to evaluate the results adequately.

After preliminary tests of an eyewall experiment were conducted in Hurricane Esther of 1961, Project Stormfury was established by agreement between the Department of Commerce and the Department of the Navy, effective July 30, 1962. In 1963, the Project seeded Hurricane Beulah.

Seeding of Esther and Beulah produced encouraging results. The seeded portion of Esther's eyewall faded from a radarscope that detects water droplets, indicating either a change of liquid water to ice crystals or the replacement of large droplets by much smaller ones. Soon after Beulah was seeded, the central pressure of the eye rose and the area of maximum winds moved away from the storm center.



A hurricane may be several hundred miles across and ten miles in height. Its strongest winds are found in a ring around the eye.

HURRICANE DEBBIE EXPERIMENTS—1969

The modification experiments on Hurricane Debbie in 1969 were the first since 1961 and 1963, and the first ever to seed a storm more than once per day. Debbie was seeded five times in an eight-hour period on both August 18 and August 20.

On August 18, Debbie was a mature hurricane with maximum winds exceeding 100 knots. It was located about 650 nautical miles east-northeast of Puerto Rico, moving towards the west-northwest.

The seeding aircraft -- flying at an altitude of 33,000 feet -- penetrated the eyewall to the area of maximum winds before starting to seed. Then, 208 silver iodide generators were dropped on a line extending across the outer wall and into the adjacent rainbands which help fuel the storm. This was repeated five times, at two-hour intervals. Each seeding run lasted two to three minutes over a path 14 to 20 nautical miles in length.

Before the first seeding on August 18, maximum winds at 12,000 feet were 98 knots. Five hours after the fifth seeding, they were 68 knots -- 31 percent less than before the experiment began.

On August 20, the storm had a double eye, an unusual structure in hurricanes and complicated to handle with present seeding techniques. However, maximum wind speed at 12,000 feet before the first seeding was 99 knots, and after the final seeding it had dropped 15 percent, to 84 knots.

Analyses of past storms show that the rate of decrease in wind speeds observed on August 18 would be very rare in an unseeded hurricane. The smaller decreases in wind speeds observed on August 20 could be expected to occur naturally in fewer than half of the unmodified storms. The fact that the storm's winds diminished on both seeding days strongly suggests that at least some of the changes were caused by the modification experiment.

HURRICANE GINGER EXPERIMENTS—1971

On September 26 and 28, 1971, Project Stormfury experiments were conducted on Hurricane Ginger.

Although Ginger was a large, diffuse storm, unsuitable for large-scale modification, it did give Project scientists their first opportunity to perform the rainsector experiment. The objectives of this experiment are to cause the clouds to grow and draw off inflowing air so that it cannot reach the eyewall region and add its energy to the core of the storm.

Clouds located in one or more of the storm's rainbands, 70 to 100 miles from the hurricane center, were selected for seeding. Seeding was performed twice on September 26, and four times on September 28. On September 26, the storm's winds had begun to increase before the seeding and continued to increase following the experiment. After the seedings on September 28, the mean maximum wind speeds decreased from 90 to 79 miles per hour, but it is doubtful that the seeding caused much of the change.

While Ginger offered little potential for modification, it yielded valuable research data which is still under study at the National Hurricane Research Laboratory.

PLANS FOR THE 1972 SEASON

The operational period will extend from July 14 through October 31.

During the 1972 season, first priority will be given to the hurricane eyemod experiments in which clouds near the hurricane eye are subjected to massive seeding over an eight-hour period. Other experiments planned for the season are seeding of hurricanes' rainsectors and spiral rainbands, and continuation of seeding experiments on lines of tropical cumulus clouds.

Seeding will be authorized in the southwestern North Atlantic, the Caribbean Sea, and the Gulf of Mexico, when the probability is small -- 10 percent or less -- that the hurricane center will come within 50 miles of a populated area within 18 hours after seeding.

Hurricane Eyemod Experiment

In each of the eyemod experiments, the clouds surrounding the hurricane eye will be seeded five times at two-hour intervals, with three supplementary seedings, 208 silver iodide pyrotechnic units being dropped on each seeding run. Specially instrumented aircraft will monitor the area from four hours before the first seeding until six hours after the final one, in order to record changes in storm characteristics.

The first plane to enter the storm is an Air Force WC-130 flying at 29,000 ft., to monitor the outflow, release dropsondes, and seed the hurricane before departing from the storm. This flight begins about four hours before the first seeding actually occurs. Similar flights are made by additional WC-130's.

About three hours before the first seeding, two more aircraft arrive. An RFF DC-6 monitor crosses back and forth through the eye and most intense portion of the storm at 5,000 ft.;and, a Navy WP-3 flies at 1,000 feet to collect oceanographic data and make two penetrations into the hurricane eye. Each of these flights is duplicated later during the experiment. Another RFF DC-6 arrives just before the fourth seeding, and the first DC-6 returns to continue monitoring the storm until about eight hours after the last seeding. A second Navy WP-3 relieves the first at about the time of the fifth seeding and continues low-level oceanographic monitoring for another eight hours. Marine A-6 aircraft make the remaining five seeding runs at two-hour intervals, flying through the storms at 34,000 feet.

Before the first seeding begins, one Navy WP-3 aircraft enters the storm at 8,000 feet as command and control aircraft and remains approximately eight hours. The alternate command and control aircraft arrives approximately two hours after the first seeding and collects meteorological data during its time on station.

The RFF WC-130 monitors cloud physics parameters in the hurricane clouds, flying between 22,000 and 24,000 feet for six hours beginning one hour prior to the first seeding.

Just before the first seeding, a WB-57F begins flying back and forth across the storm to photograph the cloud patterns from very high altitudes. This flight is repeated later in the experiment.

At about the time of first seeding, an Air Force WC-135 enters the storm to monitor outflow at 39,000 feet for approximately seven hours.

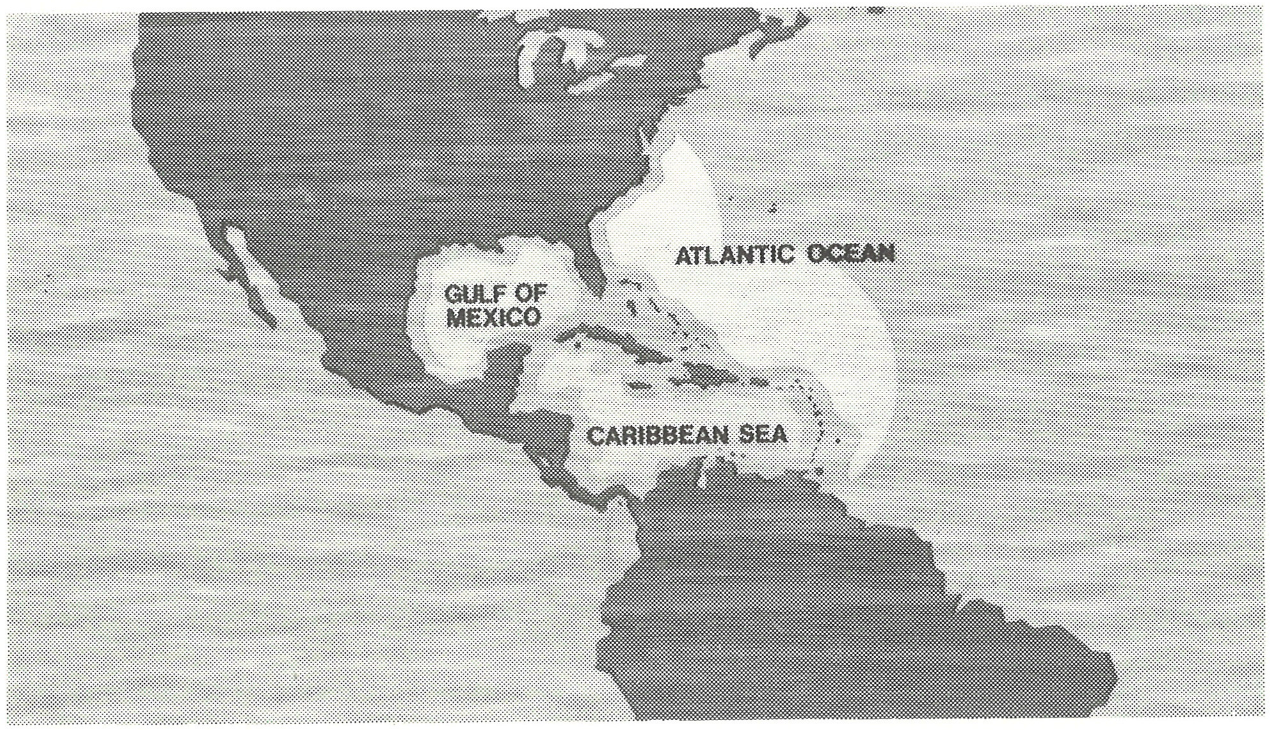
Rainsector Experiment

This experiment bridges the gap between the eyemod and rainband experiments. It involves seeding a number of rainbands in an inflow sector of the hurricane at distances of 40 to 70 miles from the center. The objective is to disperse the energy of the storm over a larger area and not let it become so concentrated in any one area, in the relatively narrow band around the center, for example. This could result in a reduction of the maximum winds in the hurricane. Seedable clouds in the sector will be treated, while monitoring aircraft continue to collect data to document changes in the storm structure or intensity. The seedings will occur during four periods of 50 minutes each separated by nonseeding periods of 50 minutes. The latter provides time for the monitoring aircraft to safely penetrate the seeding sector.

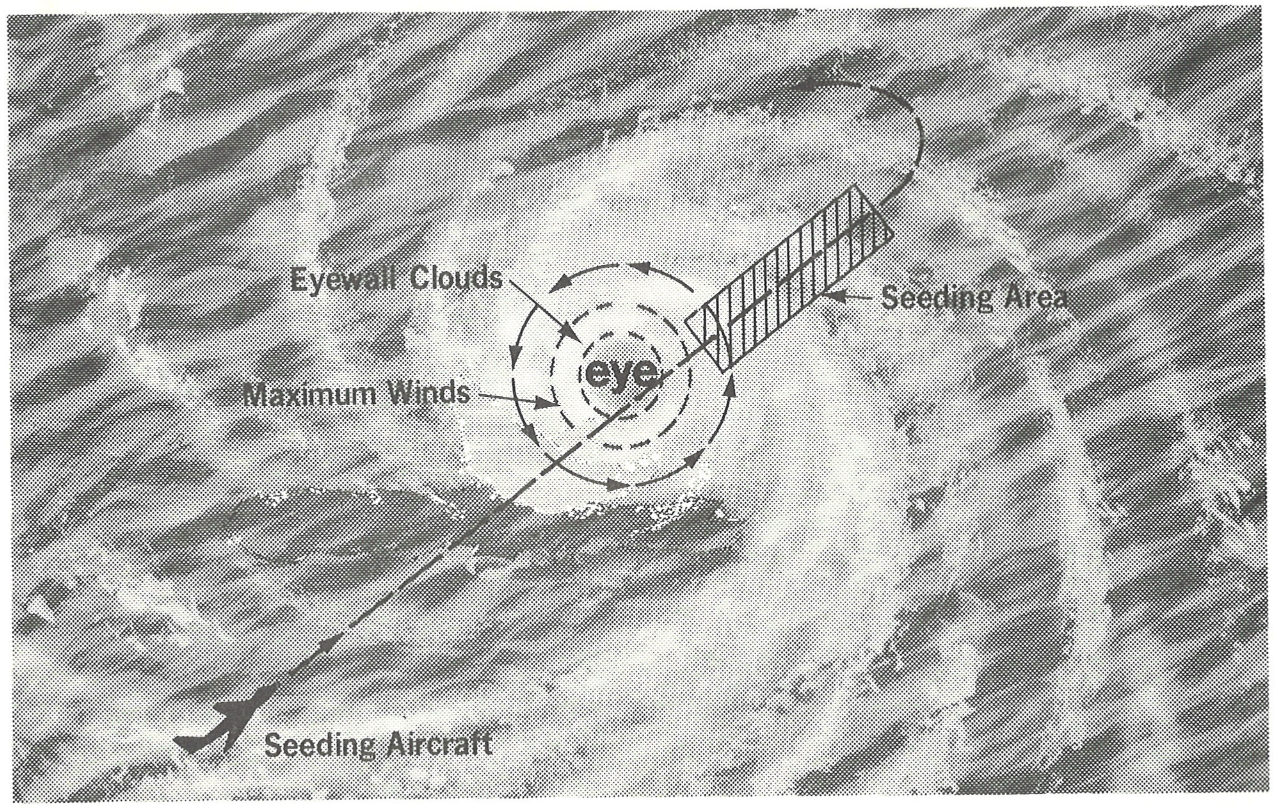
Hurricane Rainband Experiment

An experiment designed to seed a hurricane rainband will be attempted this year. Rainbands--curved bands of clouds with heavy precipitation--are normally found at some distance from the storm's eye, but may constitute an important link in the chain between relatively simple cumulus convective activity and a mature hurricane. A line of silver iodide pyrotechnic canisters will be dropped along a rainband, with monitoring before and after seeding by Project aircraft.

Authorized Seeding Areas



Flight Track for Seeding Aircraft



Cloud Line Experiment

Lines of tropical cumulus clouds have many characteristics of hurricane rainbands. Seeding in these cloud lines may yield important data and lead to more effective experiments in hurricane modification. In 1969 and 1970, lines of clouds over the ocean south of Puerto Rico were seeded, and in 1971, the experiment was conducted near Barbados.

PROJECT OFFICIALS

Dr. Robert M. White, NOAA Administrator, and Rear Admiral William J. Kotsch, U.S. Navy, Deputy Director for Operations (Environmental Services) of the Joint Chiefs of Staff, Department of Defense, have overall responsibility for direction of the Project.

The Project Stormfury Director is Dr. R. Cecil Gentry, Director of the National Hurricane Research Laboratory, Miami, Florida. The Assistant Project Director and Department of Defense Project Coordinator is Captain L.J. Underwood, U.S. Navy, Commanding Officer of the Fleet Weather Central, Norfolk, Virginia.

A Project Stormfury Advisory Panel, consisting of five prominent scientists, provides expert advice to Project officials on all scientific aspects of the program. Current members are Dr. Noel E. LaSeur, Panel Chairman, Florida State University; Dr. Charles Hosler, Pennsylvania State University; Dr. Jerome Spar, New York University; Dr. Norman Phillips, Massachusetts Institute of Technology; and Dr. Roscoe Braham, University of Chicago.

PROJECT SUPPORT FACILITIES

Aircraft

Aircraft involved in Project Stormfury include three specially instrumented planes of NOAA's Research Flight Facility (RFF). Two DC-6's and one C-130, all based at Miami, Florida, monitor the experiments by recording numerous meteorological observations from 1,500 feet to 40,000 feet. The Chief of the Research Flight Facility is Howard Mason.

WP-3 (Orion) aircraft from the Navy's Hurricane Hunter Squadron VW-4, based at NAS Jacksonville, Florida, provide airborne control of all planes in the operation and measure numerous meteorological parameters. Commander Vincent J. Schuppert, U.S. Navy, is the squadron's commanding officer.

Seeding will be performed by A-6 (Intruder) aircraft from U.S. Marine Aircraft Group 14, based at Cherry Point, North Carolina. Colonel William Fitch, U.S. Marine Corps, is the Group's commanding officer, and Major Robert F. Gore will command the detachment participating in Project Stormfury. (Air Force WC-130 aircraft will also be used as seeder planes.)

Project Stormfury Director R. Cecil Gentry (right) and Capt. L.J. Underwood, U.S.N., Assistant Director.

The USAF Air Weather Service's 53rd Weather Reconnaissance Squadron, based at Ramey Air Force Base, Puerto Rico, and commanded by Lieutenant Colonel Lawrence R. Pennington, U.S. Air Force, will provide WC-130 (Hercules) aircraft for dropsonde, wind, temperature, and pressure measurements, and for seeding. High-altitude color photography will be provided this season by another squadron of AWS's 9th Weather Reconnaissance Wing, the 58th Weather Reconnaissance Squadron, under the command of Colonel Click D. Smith, USAF. The 58th WRS flies a unique long-winged version of the RB-57, the four-jet WB-57F. High-level outflow monitoring will be accomplished by a WC-135 aircraft from the 55th Weather Reconnaissance Squadron, McClellan Air Force Base, commanded by Colonel Wilson V. Palmore, USAF.

Silver Iodide Generators

The silver iodide generators used by the Project for cloud seeding are small, compact, highly efficient pyrotechnic devices, developed by Dr. Pierre St. Amand and other scientists at the Naval Weapons Center, China Lake, California. Silver iodide is used as the seeding agent because of the similarity of its crystals to those of ice and its effectiveness in causing supercooled water drops to freeze.

The primary pyrotechnic silver iodide generator to be used this year is designated WMU-2/B. Each seeder aircraft carries 208 units.

THE RESEARCH FLIGHT FACILITY

NOAA's Research Flight Facility, or RFF, is a small team of men and aircraft that extends environmental research skyward, and makes a career of flying through violent weather. Many hundreds of hurricane penetrations are shared within the RFF. So are the hundreds of thousands of air miles flown around tornado-breeding thunderstorms, Great Lakes snow storms, the Indian Ocean monsoon, and the pattern flying in BOMEX, the Barbados Oceanographic and Meteorological Experiment.

RFF was created as a tool for hurricane research. Following a series of devastating storms along the east coast of the United States, the Congress in 1955 made the Weather Bureau responsible for setting up a severe storm research effort. The U.S. Air Force provided and operated aircraft, and the Weather Bureau installed and operated meteorological instruments. This arrangement continued until 1958 when Air Force support ended. The Weather Bureau entered the 1960 hurricane season with three of its own newly acquired aircraft. In 1961, the flight group of the then National Hurricane Research Project became part of the Weather Bureau's Office of Meteorological Research. RFF is now a major element in the weather modification group of NOAA's Environmental Research Laboratories.

Over the past eight years, this aerial team has served and cooperated with the Atomic Energy Commission, National Severe Storms Laboratory, Atlantic Oceanographic and Meteorological Laboratories, Air Resources Laboratories, and Atmospheric Physics and Chemistry Laboratory; and with several other Federal agencies, universities, and private research institutes.

Aircraft include the two DC-6A's, which are generally flown between 1,000 and 20,000 feet; a B-57A jet, used from 35,000 up to 45,000 feet; and a C-130 which is used between 1,000 and 30,000 feet.

Sometimes several, or even all, of the aircraft fly simultaneously. The DC-6A's are operated by eight-man crews--two pilots, navigator, flight engineer, two meteorologists, and two electronics specialists. Because of tight accommodations, only a pilot and a meteorologist-navigator man the B-57A. The C-130 crew consists of two pilots, navigator, flight engineer, meteorologist, and two electronics specialists, plus additional personnel as may be needed to operate any special equipment used for a specific mission.

The aircraft are crammed with such devices as differential pressure transducers, dropsondes, vortex probes, icing detectors, infrared hygrometers, water content meters, and gust probes. There are three kinds of radar, magnetic tapes for recording digital data, and oscillographs and cameras for visual records. A typical mission could produce millions of data bits and thousands of photographs.

RFF is a small organization -- 53 people and four aircraft. One of the reasons they can operate efficiently and extensively and hold to schedules is that the aircraft crews have dual skills. RFF Chief Howard Mason is also a pilot. William S. Callahan is Chief of the Operations Branch and serves as navigator for the DC-6's.

Despite its large amount of flying in rough weather, particularly in thunderstorm and hurricane areas, RFF has never had a serious accident. This can be attributed not only to personal skills and training, but also to maintenance and flying techniques.

Normal procedure for flying into a hurricane calls for the following:

Penetrate the storm in a crabbed position, that is, with the nose pointed 45-50 degrees into the wind, which flows counterclockwise around the center. This helps the aircraft fly a reasonably straight track into the eye.

Fly most of the way on autopilot. This reduces the strain on the controls and the pilot and maintains a more precise flight path. Small adjustments in airspeed are made by varying the pitch, or bite of the propellers, and not by throttling.

In leaving the storm, the aircraft is again crabbed into the wind, which is now coming from the opposite direction.

NOAA RFF DC-6A

NOAA RFF B-57A

Retired from fleet (Per Lorantkeaver 5/26/77)

U.S. NAVY HURRICANE HUNTERS

Their official title is Weather Reconnaissance Squadron Four or, in naval jargon, VW-4. But the world knows them as the famous Navy Hurricane Hunters. While they have taken a vital and active part in Project Stormfury, their prime mission is reconnaissance -- early warning of the approach of tropical storms.

The Navy has performed aerial reconnaissance in support of the joint U.S. hurricane warning service since 1943. VW-4, the seventh naval aircraft squadron assigned this mission, has been in operation since 1953. Hurricane reconnaissance techniques have improved greatly during recent years. The aircraft perform at altitudes of 500 to 1,000 feet during low-level hurricane eye penetrations. This is thought by many to be the most dangerous type of flying in the world, but time-tested procedures and highly trained flight crews have reduced the danger to a minimum. In more than 24 years of Navy hurricane flights in the Atlantic, Caribbean, and Gulf of Mexico, only one plane has been lost. That occurred in 1955 when a VW-4 aircraft, a P2V Neptune, was lost with all hands in the Caribbean while penetrating the eye of Hurricane Janet.

With the advent of powerful long-range airborne radars, a new aircraft was added to the long list of planes making storm flights. In 1955, the Navy Hurricane Hunters received the first of the WC-121N Lockheed Super Constellations. New techniques were devised, and weather reconnaissance underwent a radical change. Weather information which once took days to acquire could now be gathered on one meteorological flight. Conditions in an area of 200,000 square miles could be observed with one sweep of the powerful airborne radar. One Navy weather flight could provide information on an area encompassing 1,500,000 square miles.

However, seventeen years have gone by and the Connies are tiring, so the squadron has transitioned to a brand new aircraft, the WP-3A Orion. Experience gained during the 1971 hurricane season operating one prototype WP-3A indicates that the Orion will be a worthy successor to the Connie. It is a specially modified P-3A, fully equipped for oceanographic and meteorological reconnaissance. The backbone of its instrument package is the Navy's Data Acquisition and Logging System, commonly referred to as the DALS. This logging system is interfaced with meteorological and oceanographic data sensing systems. It is capable of automatically recording and transmitting a complete meteorological observation every thirty seconds via high frequency single sideband radio teletype. With the WP-3A's increased speed, range and altitude capabilities, it is now possible to have coverage of any portion of the hurricane breeding grounds.

Since aerial hurricane reconnaissance began, more than 665 hurricanes and tropical storms have been investigated. Recently attaining the mark of 71,000 accident-free flying hours, VW-4 logged over 11,000 of these long and arduous hours in actual hurricane reconnaissance. A total of more than 1,000 penetrations into the actual "eye" of hurricanes have been made. Flying at altitudes below 1,000 feet, the men of VW-4 ride their WP-3A Orions into winds that often reach 150-175 miles per hour.

Commander Vincent J. Schuppert, U.S. Navy, is the Commanding Officer of VW-4. Commander Paul O. Cutchen, U.S. Navy, is the Executive Officer.

WP-3A Orion *(U.S. Navy photograph)*

U.S. MARINE AIRCRAFT GROUP 14

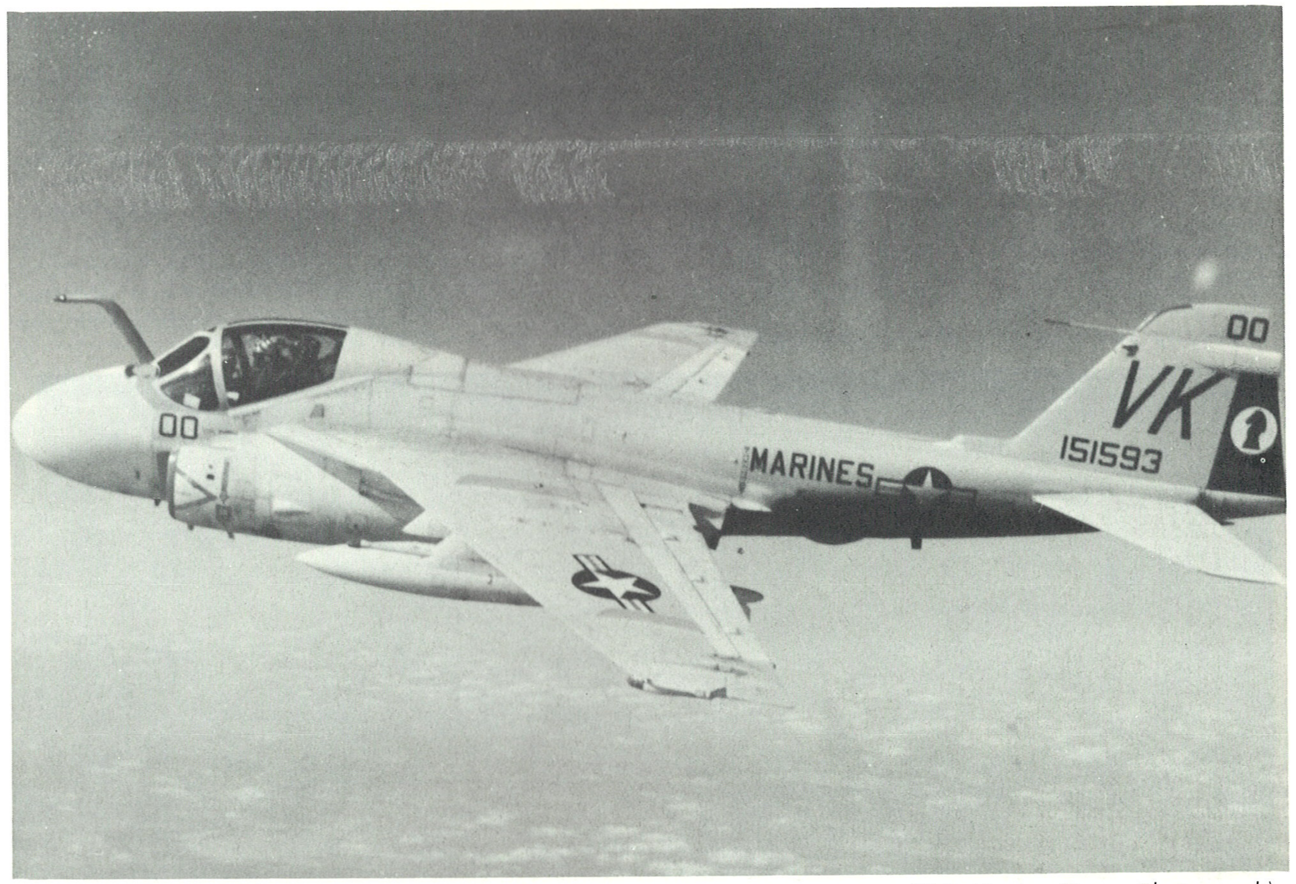
A Detachment, Marine Aircraft Group 14 and their A-6 "Intruder" aircraft will carry out seeding missions for Project Stormfury during the 1972 hurricane season. Marine Aircraft Group 14 is commanded by Colonel William Fitch, USMC.

The detachment, commanded by Major Robert F. Gore, comprises officers and men from Marine All Weather Attack Squadron 121 and Marine All Weather Attack Squadron 332, based at Marine Corps Air Station, Cherry Point, North Carolina.

The "Intruder" aircraft is a highly sophisticated, Grumman-built, twin-jet plane utilizing an airborne computer system, long-range radars, and inertial guidance system to perform its mission regardless of the weather conditions. This sophisticated instrumentation, together with the aircraft's heavy load-carrying capability and long range, make it well suited to precision seeding of hurricanes.

Marine All Weather Attack Squadron 121, commanded by Lieutenant Colonel Mark Fountain, is the most highly decorated squadron in marine history, responsible for downing over 200 enemy aircraft in World War II. Many of the famous "aces" in marine aviation served in this squadron during the war, including Medal of Honor winner Captain Joe Foss. Its long combat history includes the battles of Guadalcanal, New Georgia-Rendova, Peleliu, Southern Solomons, Palau Islands, Korea, as well as three tours in Vietnam. In February 1969, the squadron was returned to the United States where it was reorganized, given the Marine Corps' most advanced aircraft, and redesignated an All Weather Attack Squadron.

Marine All Weather Attack Squadron 332, commanded by Lieutenant Colonel Clay Comfort, was organized late in World War II and provided air cover for convoys in the Central Pacific during the later stages of the war. The squadron was reactivated for the Korean War and has served in Korea, Okinawa, Phillipines, Japan, and on various aircraft carriers. In 1962, the squadron was deployed to Thailand as part of a Marine Expeditionary Brigade. More recently, the squadron has been instrumental in training replacement aircrews.



A-6 "Intruder" aircraft *(U.S. Marine Corps Photograph)*

U.S. AIR FORCE HURRICANE HUNTERS

Air Force "Hurricane Hunters" of the Air Weather Service have provided the National Weather Service with round-the-clock hurricane warning information since 1944. Although this is only a portion of the 53rd Weather Reconnaissance Squadron's mission, it is for this that they are most famous.

Based at Ramey Air Force Base in Puerto Rico, the squadron, commanded by Lieutenant Colonel Lawrence E. Pennington, has nine WC-130 aircraft and some 400 officers and airmen poised in the middle of the tropical storm breeding grounds. From Puerto Rico, the unit searches out developing storms as far as 2,000 miles away and follows the storms as they mature and move over land or die out at sea.

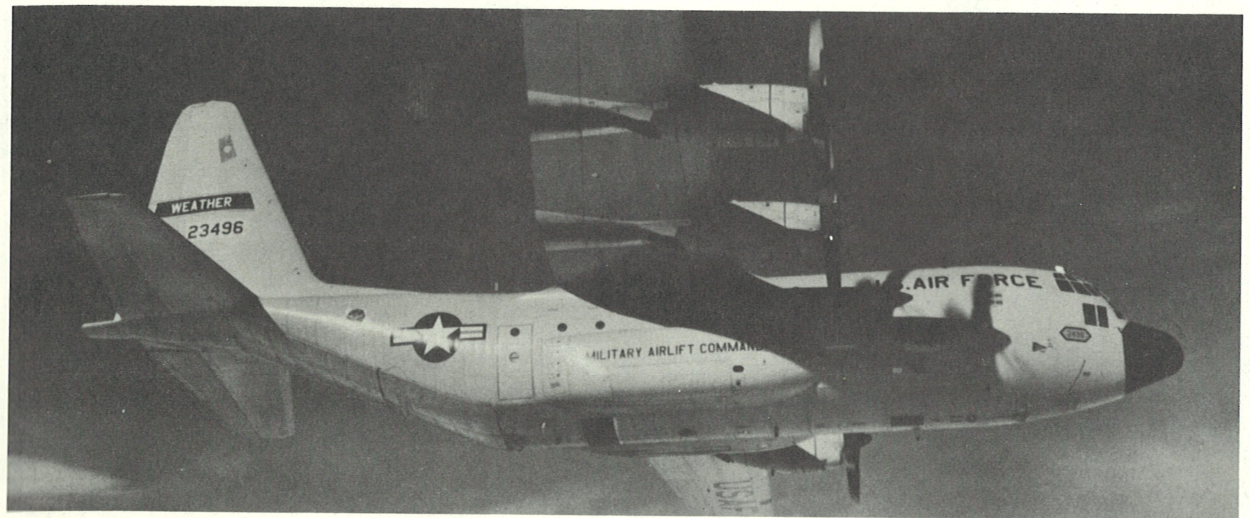
While hurricane reconnaissance is the most colorful aspect of the squadron's mission, it has spent thousands of hours in support of other projects such as investigating recovery areas for manned space flights and, outside of hurricane season, flying reconnaissance on winter storms in the Atlantic.

Every day, its air crews fly along predetermined routes in WC-130 aircraft, collecting information on winds, temperature, humidity, pressure, icing, turbulence, sea conditions, and cloud formations at designated points. Since these observations are taken at nearly the same time each day and at the same point above the sea, it is like having a weather station at that point, even though it may be thousands of miles from any land. Except for occasional ship reports, the information obtained is the only data available for these ocean areas.

During the winter months, the squadron concentrates on the area north of Puerto Rico. Its tracks include the Gulf of Mexico, the waters off the east coast of the United States as far north as Nova Scotia, and the Atlantic Ocean to the Azores Islands located 800 miles west of Portugal. The weather information gathered is radioed to a ground station and relayed to weather forecasting agencies throughout the world. Thus, the weather data gathered by the 53rd Weather Reconnaissance Squadron offers information used in preparing global weather forecasts and provides for safe and efficient travel through these areas of relatively unknown weather conditions.

In summer, the area of prime concern moves southward into the breeding grounds of tropical storms. Puerto Rico is in the midst of this area, and the routes flown by the squadron radiate in all directions from the island to seek out conditions favorable for storm development. When hurricanes do develop, the unit collects weather data in and around the storm and follows it continuously until it reaches land. Aircraft penetrations into the very eye of the storm are made as often as every three hours, and planes have remained in a storm for eight hours and longer. The data is relayed immediately by radio to NOAA's National Hurricane Center in Miami, Florida, where it is used in preparing hurricane forecasts and warnings.

During the hurricane season, the WC-130 Hercules seeks out and probes into tropical depressions and storms at 1,500 feet. To maintain a margin of safety as the storms increase in violence, the aircraft climb to penetrate hurricanes at 10,000 feet. Once in a storm, the WC-130 can gather data up to 30,000 feet.



WC-130 Hercules *(U.S. Air Force photograph)*

U.S. AIR FORCE 58th WEATHER RECONNAISSANCE SQUADRON

The Air Weather Service's 58th Weather Reconnaissance Squadron is based at Kirtland Air Force Base, New Mexico, under the command of Colonel Click D. Smith. The squadron flies a unique long-winged version of the RB-57, the four-engine WB-57F.

An important task is flying WB-57F missions from the north polar ice cap to areas far south of the Equator to explore the upper air for data on nuclear debris, cosmic dust and the effects of solar radiation.

Upper-air gaseous samples are trapped in basketball-size spheres located in the bomb bay. And, on the exterior, special filters placed in a pod located on the bottom of the WB-57F collect particles from the atmosphere. The samples, in many cases, are turned over to the Federal Aviation Administration for further study.

Solar radiation is also measured on these high-altitude sampling missions. In this function, research is paving the way for the future supersonic transports, which will fly above the atmospheric shield.

In February 1969, a huge meteorite entered the atmosphere over Mexico. In January 1970, another giant meteorite fell over Kansas and Oklahoma, causing a sonic boom to be heard in several cities. In both cases, WB-57F's from the 58th were in a track through the areas within two hours after the meteorite was sighted. Particles left in the trail of the disintegrating meteorite were collected and sent to the Smithsonian Astrophysical Observatory for examination.

As a lesser, but spectacular duty, the squadron photographs hurricanes. When Hurricane Beulah was on the rampage in 1967, a WB-57F from the 58th took the first color photo of a hurricane eye.

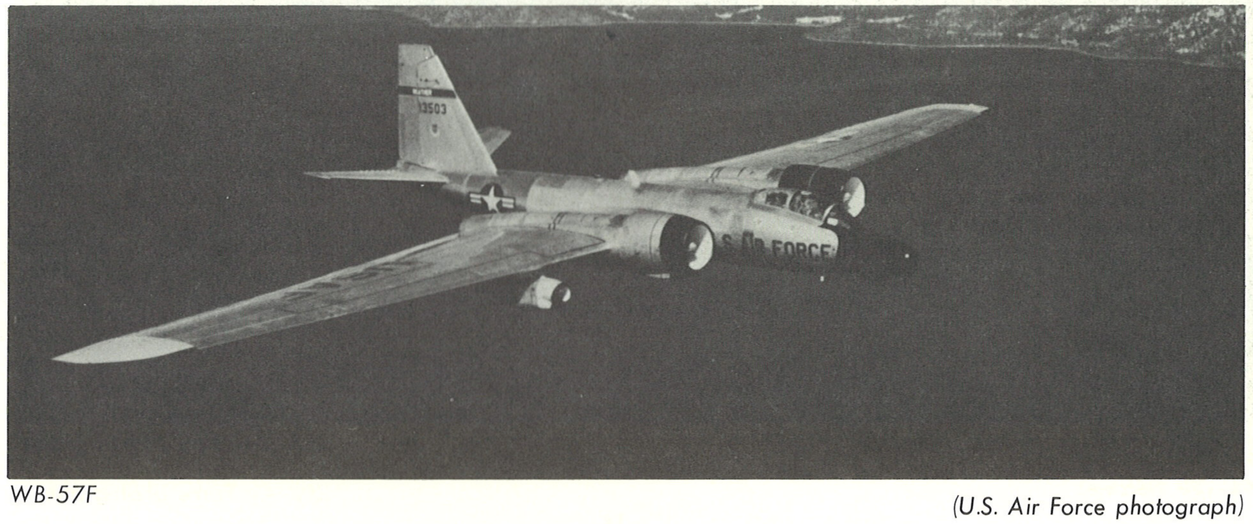
The men who fly the WB-57F are placed in an unusual status. WB-57F crews face many of the same problems as astronauts. They fly in atmosphere which closely approaches outer space conditions. Their mission is to probe the upper atmosphere in support of special research projects.

Twenty-four hours before take-off, the air crew begins a controlled diet of high protein, low residue, nongaseous foods. Maintenance crews begin the detailed check of the aircraft. All flight planning and pre-mission briefings are accomplished at least 15 hours before take-off.

About two hours before launch, the crew (and a back-up crew) have their prescribed breakfast of steak and eggs. Meanwhile, their pressure suits are tested and re-tested by the life support technicians. After breakfast, the flight surgeon supervises a physical examination of the air crew while the back-up crew completes a ground check of the 57F and starts the engines.

The crew, wearing pressure suits which closely resemble astronaut apparel, move out to the aircraft. They ride comfortably in a pressure van with their suits plugged into an air conditioning system.

Shortly after take-off, the WB-57F is out of sight of ground crews and is flying amidst 200 mph winds and minus 115 degree temperatures. On the ground, the support people are already preparing another aircraft and crew for the next mission.



WB-57F *(U.S. Air Force photograph)*

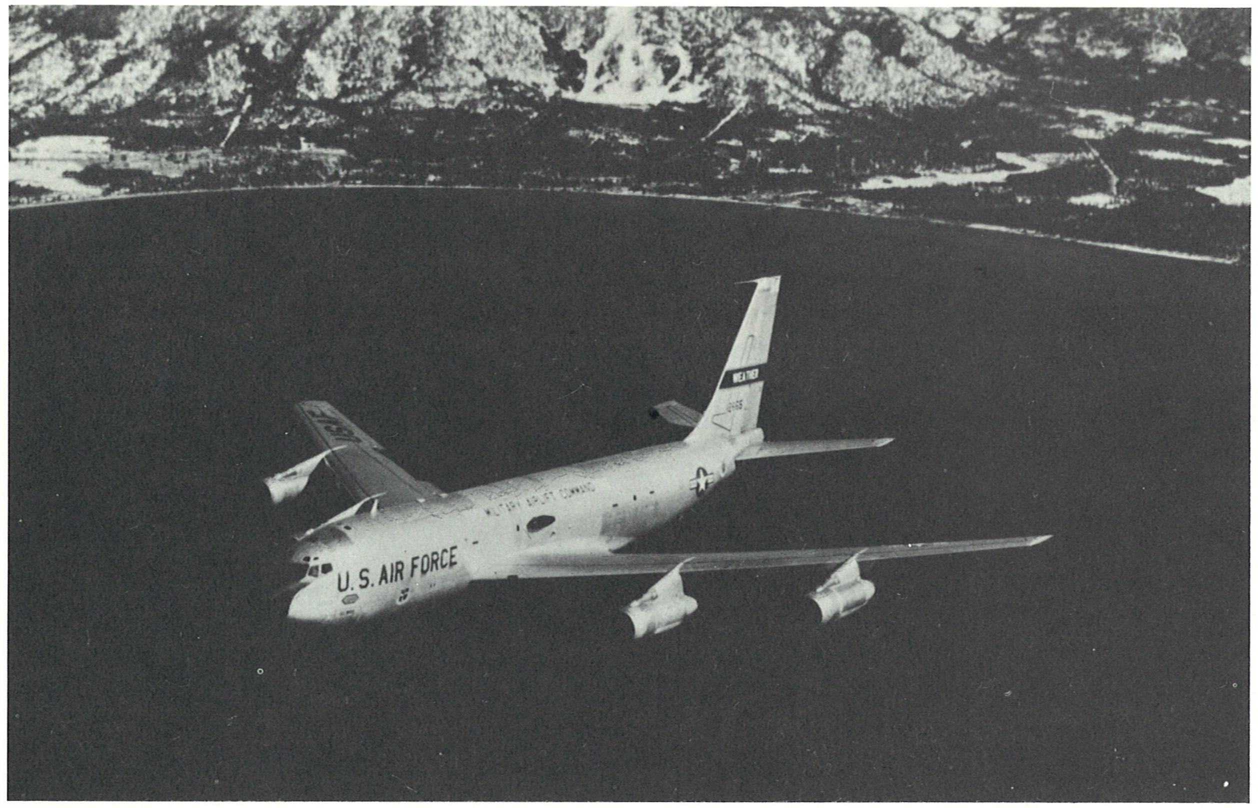
U.S. AIR FORCE, 55TH WEATHER RECONNAISSANCE SQUADRON

The 55th Weather Reconnaissance Squadron, a unit of Air Weather Service located at McClellan Air Force Base, California, is commanded by Colonel Wilson V. Palmore. The squadron uses five WC-135B aircraft and four WC-130B aircraft in their performance of eastern Pacific storm reconnaissance as directed by National Weather Service. Information gathered from these flights is fed into the Air Force Global Weather Central via the hurricane net.

Routine weather flights are made on a daily basis and special missions are flown to search out cyclonic disturbances, tropical storms and hurricanes. In addition to their storm responsibilities, the squadron supports the Department of Defense, Air Force Systems Command, Air Force Cambridge Research Laboratories and Tactical Air Command. The 55th has also provided launch and recovery weather reconnaissance for Apollo missions 8, 13 and 14.

Much of the weather data gathered by the WC-135s is processed by computer. The aircraft carries a computer, printer and teletype machine which are tied into a central control panel. The computer and related equipment, known as the AMQ25 system, collect weather data both horizontally and vertically. Basic horizontal data consists of pressure, altitude, temperature, and wind at a given latitude and longitude. Four external sensors assist in the collection of this data which is then fed into the computer. Vertical data is collected by the use of a dropsonde. This instrument is ejected from the aircraft and data is sent back to the aircraft by means of a small internal radio. The computer stores the information until the sonde ceases to operate. The data from both types of sensing devices is automatically converted to standard weather coding and then placed on a tape for transmission to ground receiving stations via the teletype system aboard the aircraft.

The WC-130s maintained by the squadron perform the majority of the storm reconnaissance requirements in the Eastern Pacific augmenting the "Hurricane Hunters" in the Atlantic and the "Typhoon Chasers" in the Western Pacific.



WC-135 *(U.S. Air Force Photograph)*